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UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 C.F.R. § 1.53 (b))

Attorney Docket No. 21513
First Inventor or Application Identifier: von Würtemberg, Rickard Marcks
Title: Bottom Emitting VCSEL (Vertical Cavity Surface Emitting Laser) With Monitor Emulsion Through Top Mirror
Express Mail Label No.

jc511 U.S. PTO 09/438955 11/12/99

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
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1. [X] *Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)
2. [X] Specification [Total Pages 6]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

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3. [X] Drawing(s) (35 U.S.C. 113) [Total Pages 2]
4. Oath or Declaration [Total Pages]
a. [ ] Newly executed (original or copy)
b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d)) (for continuation/divisional with Box 17 completed)
(Note Box 5 below)
i. [ ] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. § 163(d)(2) and 133 (b).
5. [ ] Incorporation By Reference (useable if Box 4b is checked). The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. [ ] Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
a. [ ] Computer Readable Copy
b. [ ] Paper Copy (identical to computer copy)
c. [ ] Statement verifying identify of above copies

ACCOMPANYING APPLICATION PARTS

8. [ ] Assignment Papers (cover sheet & document(s))
9. [ ] 37 C.F.R. § 3.73(b) Statement (when there is an assignee) [ ] Power of Attorney
10. [ ] English translation Document (if applicable)
11. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations
12. [ ] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
*Small Entity)
14. [ ] Statement(s) (PTO/SB/09-12) [ ] Statement filed in prior application, Status still proper and desired
15. [ ] Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. [ ] Other: ....

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17. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No.: ______/________________
Prior application information: Examiner ____________________ Group/Art Unit: ________________

18. CORRESPONDENCE ADDRESS

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SUBMITTED BY:			
Name (Print/Type)	Lawrence E. Laubscher, Jr.	**Registration No.** (Attorney/Agent)	28,233
Signature		**Date**	11/12/99

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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS of C.F.R. § 1.16(c) or (j))	17 - 20* =	0	x $ 0 =	$ 0
	INDEPENDENT CLAIMS of C.F.R. § 1.16(c) or (i))	2 - 3** =	0	x $ 0 =	0
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 C.F.R. § 1.16(d))			x $ 0 =	0
				BASIC FEE (37 C.F.R. § 1.16)	$760.00
				Total of above Calculations	$ 0.00
	Reduction by 50% for filing by small entity (Note 37 C.F.R. §§ 1.9, 1.27 & 1.28).				
	* Reissue claims in excess of 20 and over original patent. ** Reissue Independent claims over original patent.			TOTAL =	$760.00

6. Small entity status:
   a. ☐ A small entity statement is enclosed, if (b) and (c) do not apply.
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7. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 12-0605:
   a. ☒ Fees required under 37 C.F.R. § 1.16.
   b. ☒ Fees required under 37 C.F.R. § 1.17.
   c. ☒ Fees required under 37 C.F.R. § 1.18.
8. ☒ A check in the amount of $760.00 is enclosed.
9. ☐ Other: ______________________________

NOTE: The prior application's correspondence address will carry over to this CPA UNLESS a new correspondence address is provided below.

10. NEW CORRESPONDENCE ADDRESS

☐ Customer Number or Bar Code Label	(Insert Customer No. or Attach bar code label here)	or ☒ New correspondence address below

Name	Lawrence E. Laubscher, Jr. Laubscher & Laubscher				
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City	Arlington	**State**	Virginia	**Zip Code**	22202
Country	U. S. A.	**Telephone**	(703) 521-2660	**Fax**	(703) 553-0174

11. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Name (Print/Type)	Lawrence E. Laubscher, Jr.	**Registration No.** (Attorney/Agent)	28,233
Signature	[signature]	**Date**	11/12/99

BOTTOM EMITTING VCSEL (VERTICAL CAVITY SURFACE EMITTING LASER) WITH MONITOR EMISSION THROUGH TOP MIRROR

FIELD OF THE INVENTION

The present invention relates to a method of monitoring the light output from a VCSEL and more particularly, the present invention relates to a method of monitoring the light emission from a VCSEL without interfering with the light output from the VCSEL.

BACKGROUND OF THE INVENTION

Previously, when mounted in a header, light that was reflected from the top lens of the VCSEL back into the header was monitored with a Si photodiode, on which the VCSEL chip was mounted. Presently, the art has not recognized any method of monitoring the light from a VCSEL chip that is not mounted in a header. The use of a header is required in existing systems to monitor light emission.

In many applications it is desirable to know for certain that the VCSEL is in fact emitting light upon current being driven through it. The problem is to monitor this light without disturbing the lightbeam too much, and to conduct this in an affordable manner that does not require complex packaging.

The present invention provides methodology to monitor the light emission from a VCSEL without in any way obstructing and/or disturbing the output light. It also eliminates the need of mounting the VCSEL chip in a header just to monitor its output light.

SUMMARY OF THE INVENTION

One object of one embodiment of the present invention is to provide a surface emitting laser, comprising:

a plurality of spaced apart mirrors;

a light amplifying region between the mirrors;

a substrate; and

a photon transparent ohmic contact for passing light energy therethrough whereby light emission through the surface emitting laser may be monitored.

A further object of one embodiment of the present invention is to provide a method for monitoring light emission from a surface emitting laser, the laser including:

a plurality of spaced apart mirrors;

a light amplifying region between the mirrors;

a substrate;

a photon transparent ohmic contact;

contacting the laser with a source of energy to generate light; and

monitoring emitted light transmitted through the transparent ohmic contact.

Having thus generally described the invention reference will now be made to the accompanying drawings illustrating preferred embodiments.

Figure 1 is a schematic illustration of the prior art arrangement for monitoring light output;

Figure 2 is a schematic illustration of a standard VCSEL showing the loss of light to the substrate; and

Figure 3 is a schematic illustration of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Similar elements employed in the drawings denote similar elements.

Referring now to the drawings, Figure 1 depicts a conventional arrangement, generally denoted by numeral 10, for monitoring light 12 emitted from a VCSEL 14. The light 12 reflected from top lens 16 and on to photo diode 18. In this embodiment, the light is detectable only by the photo diode and as such, the arrangement is limited as discussed hereinabove.

In Figure 2, a standard VCSEL is illustrated having an ohmic contact 20, a substrate 22 and reflective mirrors, the high reflectivity mirror being denoted by numeral 24 and the low denoted by numeral 26.

As is known with VCSELs, one of the two mirrors reflects less (and transmits more) of the light incident upon it from the amplifying region. The light transmitted through this less reflecting mirror is the light that is emitted from the VCSEL. This light is shown in Figure 1 by the arrow indicated by numeral 28. In the standard top-emitting VCSEL illustrated, light denoted by arrow 30 is lost as it is emitted into the substrate 22 below the bottom (high reflectivity) mirror 24 if it is not of a wavelength to which the substrate is transparent. However, in a bottom emitting VCSEL, shown in Figure 3, where the light emitted through the less reflecting mirror 26 passes through a hole 32' in the substrate, nothing stops the light 28 that is transmitted through the high reflectivity mirror 24, except the ohmic contact 34 that is placed on the other side of that mirror. By providing an aperture 32 in the ohmic contact 34, it is possible to extract that light and monitor it with a diode (not shown) on which the VCSEL chip 14 can be placed.

Generally speaking, a photon transparent contact is one that allows light emission through it via an aperture or is made of a transparent material. Further, the contact may be made sufficiently thin to allow passage of light or the contact may incorporate a combination of these features.

In a further aspect of the invention, the same can be used for any bottom-emitting VCSEL, including those that have wavelengths for which the substrate is transparent. Where the substrate is transparent, no aperture has to be made through the substrate in order to allow primary (i.e. not the monitor) light to be extracted from the VCSEL structure. For such VCSELs, the standard VCSEL design allows the monitor light to be extracted through the substrate, making bottom emission of the primary light unnecessary. To extract the monitor light through the ohmic contact (for both standard and bottom emitting VCSELs), it is not necessary to make an aperture in the contact. Instead, the contact may be made out of a photon transparent material (for example, but not limited to, ITO (Indium Tin Oxide)), or the contact can be made sufficiently thin to allow light to pass through it. In this regard, the contact may have a thickness of between 1 nm (nanometer) and 100 nm.

Although embodiments of the invention have been described above, it is not limited thereto and it will be apparent to those skilled in the art that numerous modifications form part of the present invention insofar as they do not depart from the spirit, nature and scope of the claimed and described invention.

WE CLAIM:

1. A surface emitting laser, comprising:

a plurality of spaced apart mirrors;

a light amplifying region between said mirrors;

a substrate; and

a photon transparent ohmic contact for passing light energy therethrough whereby light emission through said surface emitting laser may be monitored.

2. The laser as set forth in claim 1, wherein said photon transparent ohmic contact is positioned on said substrate.

3. The laser as set forth in claim 1, wherein said photon transparent ohmic contact is positioned on an epitaxial side of said laser.

4. The laser as set forth in claim 1, wherein said surface emitting laser is a top emitting vertical cavity surface emitting laser.

5. The laser as set forth in claim 1, wherein said surface emitting laser is a bottom emitting vertical cavity surface emitting laser.

6. The laser as set forth in claim 1, wherein said transparent ohmic contact comprises a contact devoid of apertures.

7. The laser as set forth in claim 1, wherein said ohmic contact has a thickness between 1 nanometer and 100 nanometers.

8. The laser as set forth in claim 1, wherein said ohmic contact comprises indium tin oxide.

9. The laser as set forth in claim 1, wherein said mirrors have equivalent reflectivity.

10. The laser as set forth in claim 1, wherein said mirrors have reversed reflectivity.

11. A method for monitoring light emission from a surface emitting laser, said laser including:

a plurality of spaced apart mirrors;

a light amplifying region between said mirrors;

a substrate;

a photon transparent ohmic contact;

contacting said laser with a source of energy to generate light; and

monitoring emitted light transmitted through said transparent ohmic contact.

12. The method as set forth in claim 11, wherein said laser is a bottom emitting vertical cavity surface emitting laser.

13. The method as set forth in claim 12, further including the step of providing mirrors with equivalent reflectivity.

14. The method as set forth in claim 12, wherein said ohmic contact comprises indium tin oxide.

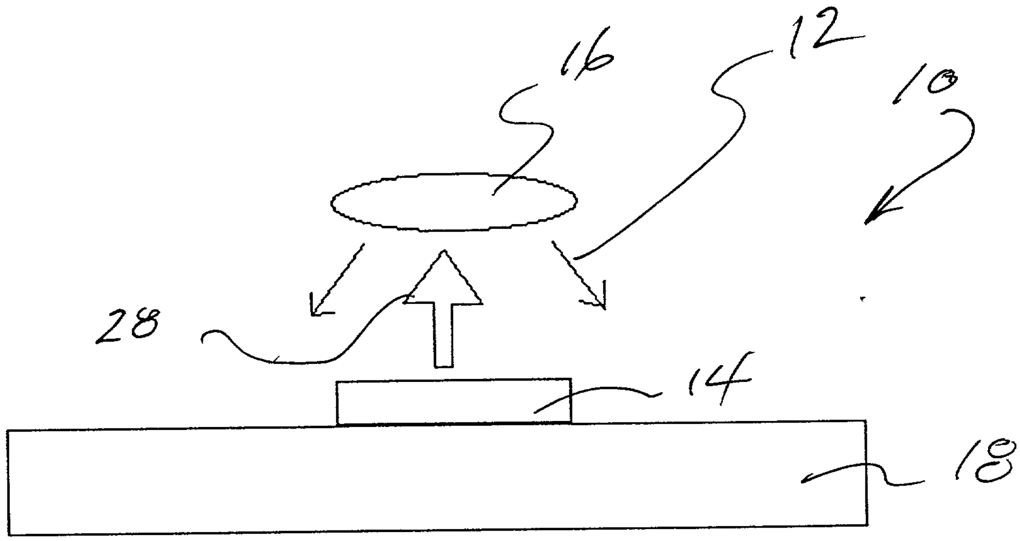
15. The method as set forth in claim 11, further including the step of providing mirrors with reversed reflectivity.

16. The method as set forth in claim 11, wherein said photon transparent contact is positioned on said substrate.

17. The method as set forth in claim 11, wherein said photon transparent contact is positioned on an epitaxial side of a bottom emitting vertical cavity surface emitting laser.

ABSTRACT

A bottom emitting VCSEL where the light emitted can be monitored without obstruction. No additional mountings are required, such as a header, to monitor output, which mountings are necessary in prior art arrangements.



PRIOR ART FIG. 1.

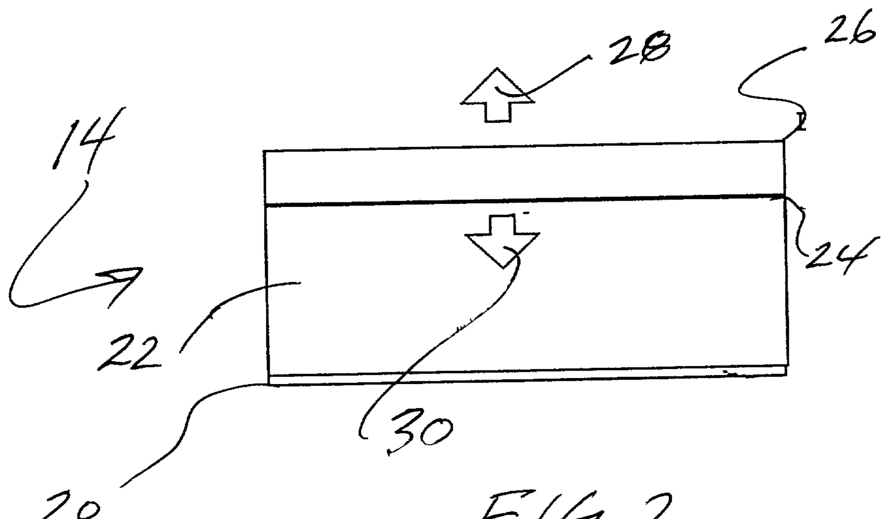


FIG. 2.

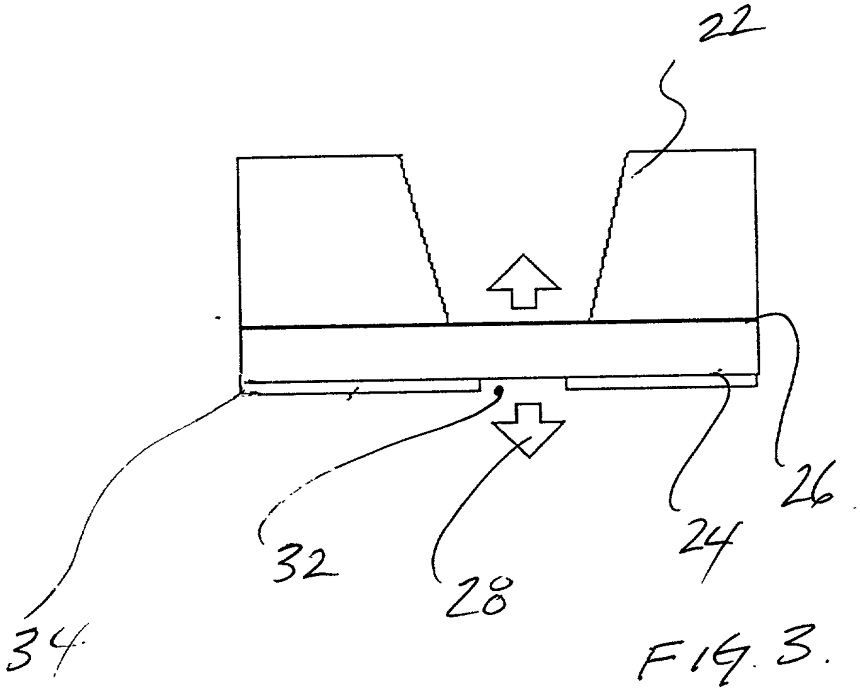


FIG. 3.